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OCCUPANT PROTECTION SYSTEM FOR A MOTOR VEHICLE

Description

The present invention relates to an occupant protection system for a motor vehicle. Such an occupant protection system may include an airbag and/or a belt tensioner.

Airbag systems are disclosed, for example, in the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf.

U.S. 5,583,771, U.S. 5,684,701 and U.S. 6,532,508 B1 describe the triggering of an airbag by a neural network as a function of an output signal of an acceleration sensor.

DE 198 54 380 A1 describes a method for detecting the severity of a vehicle collision, where the output signals of a plurality of acceleration sensors are supplied to a neural network. In the method, the start of the evaluation of the acceleration-sensor output signals is determined by a trigger signal, which is output by an acceleration sensor when it output signal exceeds a predefined threshold value. This acceleration sensor causes the other acceleration sensors to supply the specific output signal at one and the same time. It is also provided that the output signals of the acceleration sensors be integrated one or two times.

DE 100 35 505 A1 describes a method, in which the future time characteristic of the output signal of an acceleration sensor is predicted with the aid of a neural network on the basis of the acceleration-sensor signals at at least one defined time.

DE 100 40 111 A1 describes a method for producing a triggering decision for restraining devices in a vehicle, where the difference of measured acceleration values is calculated and the magnitude of the difference is subsequently integrated. The integral is compared to at least one threshold value. If the integral does not exceed this threshold value by a predefined time, then the position of a triggering threshold for the measured acceleration or for a speed change derived from it is modified in such a manner, that the triggering sensitivity becomes lower.

Described in DE 101 03 661 C1 is a method for sensing lateral impact in a motor vehicle; acceleration sensors, from whose output signals the difference is calculated, being situated on the left and right sides of the vehicle. The differential acceleration signal is integrated or summed up. For the purpose of side-impact sensing, the differential speed signal is compared to a threshold value, which is calculated as a function of the differential acceleration signal.

The object of the present invention is to provide an improved occupant protection system for a motor vehicle, in particular an occupant protection system including an airbag and/or a belt tensioner. In so doing, it is particularly desirable for the triggering of such an occupant protection system for a motor vehicle to be especially precise.

The above-mentioned object is achieved by an occupant protection system for a motor vehicle having at least one crash sensor for measuring a motion variable of the motor vehicle, the occupant protection system including an occupant protection device controllable via an ignition signal, and a control unit for ascertaining or generating the ignition signal as a function of a time average, over at least a first time interval, of the motion variable measured by the crash

sensor, and, advantageously, as a function of a time average of the motion variable measured by the crash sensor, over a second time interval different from the first time interval.

An occupant protection device within the meaning of the present invention is, in particular, an airbag and/or a belt tensioner.

An average value within the meaning of the present invention may be an arithmetic mean or a weighted average. In the case of such a weighted average, e.g. more recent values of the motion variable in the relevant time interval may be more heavily weighted than older values of the motion variable in the relevant time interval. An average value within the meaning of the present invention may also be a value proportional to an average value. In an advantageous refinement of the present invention, the average value is a value proportional to the arithmetic mean. In this context, the average value is advantageously a value proportional to the integral of the motion variable in the relevant time interval or the sum of sampled values of the motion variable in the relevant time interval.

A motion variable of the motor vehicle within the meaning of the present invention may be an acceleration, a speed, or a displacement, or a variable derived from one of these variables. In this context, the motion variable is advantageously an acceleration.

A crash sensor within the meaning of the present invention may be an acceleration sensor for measuring an acceleration in one or more directions. A crash sensor within the meaning of the present invention may also be a radar device, an infrared set-up, or a camera. In this case, a motion variable of the motor vehicle may be a distance of the motor vehicle from an

obstacle, the first or second derivative of this distance, or another equivalent variable. A crash sensor within the meaning of the present invention may also be a sensor for measuring a deformation of the motor vehicle. Such a sensor may be a fiber-optic sensor or a sensor described in DE 100 16 142 Al. In this case, a motion variable of the motor vehicle may be a deformation of the motor vehicle, the first or second derivative of this deformation, or another equivalent variable.

An ignition signal within the meaning of the present invention may be a binary signal, which indicates if an occupant protection device, such as an airbag and/or a belt tensioner, should be triggered. Such an ignition signal within the meaning of the present invention may be a "FIRE/NO-FIRE" signal described in DE 100 35 505 Al. An ignition signal within the meaning of the present invention may also be a more complex signal, which indicates the degree (e.g. stage 1 or stage 2) to which an airbag should be fired. In addition, such an ignition signal within the meaning of the present invention may be a crash-severity parameter or an occupant acceleration or loading described in DE 100 35 505 A1. An ignition signal within the meaning of the present invention may be, or include, an information item indicating the location and/or the direction of a collision.

Within the meaning of the present invention, a second time interval different from a first time interval may differ from the first time interval in its length and/or its position.

In a further advantageous refinement of the present invention, the ignition signal is ascertainable by the control unit as a function of time averages of the motion variable measured by the crash sensor in two to twenty, advantageously in two to ten, different time intervals. In a further advantageous

refinement of the present invention, the ignition signal is ascertainable by the control unit as a function of time averages of the motion variable measured by the crash sensor in two to five different time intervals. Different time intervals within the meaning of the present invention may differ from each other in the length and/or in the position.

In a further advantageous refinement of the present invention, the time intervals are between 1 ms and 200 ms long, in particular between 4 ms and 32 ms long, and advantageously between 8 ms and 24 ms long. In one refinement of the present invention, the time intervals are essentially the same length, or they vary in length.

In a further advantageous refinement of the present invention, at least two, in particular adjacent, time intervals are staggered by between 1 ms and 50 ms, advantageously by between 2 ms and 16 ms. In a further advantageous refinement of the present invention, all adjacent time intervals are each offset from each other by between 1 ms and 50 ms, advantageously by between 2 ms and 16 ms.

In a further advantageous refinement of the present invention, the occupant protection system includes at least one additional crash sensor for measuring a motion variable of the motor vehicle, the ignition signal also being ascertainable by the control unit as a function of at least one time average of the motion variable measured by the additional crash sensor over a time interval. In a further advantageous refinement of the present invention, the additional crash sensor is positioned more than 0.5 m away from the crash sensor mentioned at the outset.

The above-mentioned object is additionally achieved by a motor vehicle, in particular a motor vehicle including an occupant

protection system that has one or more of the above-mentioned features, the motor vehicle including at least one crash sensor for measuring a motion vehicle of the motor vehicle and an occupant protection device controllable via an ignition signal, the motor vehicle including a control unit for ascertaining or generating the ignition signal as a function of a time average of the motion variable measured by the crash sensor over at least one first time interval, and advantageously as a function of a second time interval of the motion variable measured by the crash sensor over a second time interval different from the first time interval.

The above-mentioned object is additionally achieved by a method for operating an occupant protection system for a motor vehicle, in particular by a method for operating an occupant protection system, having one or more of the above-mentioned features, the occupant protection system including an occupant protection device controllable via an ignition signal, and the ignition signal being ascertained as a function of a time average of a measured motion variable over at least one first time interval, and advantageously as a function of a time average of the measured motion variable over a second time interval different from the first time interval.

A motor vehicle within the meaning of the present invention is, in particular, a land vehicle that may be used individually in road traffic. In particular, motor vehicles in the sense of the present invention are not restricted to land vehicles having an internal combustion engine.

Further advantages and details are derived from the following description of exemplary embodiments, objects that are identical or substantially identical being denoted by the same reference numerals. The figures show:

Fig. 1 a plan view of a motor vehicle;

Fig. 2 an exemplary embodiment of an occupant protection system;

Fig. 3 an exemplary embodiment of a control module;

Fig. 4 an exemplary embodiment of a triggering module;

Fig. 5 an exemplary embodiment of an output signal of a crash sensor;

Fig. 6 the integral of the output signal of Fig. 5, in one time interval;

Fig. 7 an exemplary embodiment of a neural network;

Fig. 8 an exemplary embodiment of a decision tree;

Fig. 9 a further exemplary embodiment of a triggering module;

Fig. 10 a further exemplary embodiment of a triggering module; and

Fig. 11 a further exemplary embodiment of a triggering module.

Fig. 1 shows a plan view of a motor vehicle 1 having an occupant protection system, which is represented in Fig. 2 in the form of a block diagram. The occupant protection system includes at least an airbag 15, which is not represented in Fig. 1 but in Fig. 2, and/or a belt tensioner 16, which is not represented in Fig. 1 but in Fig. 2. The occupant protection system additionally includes a control unit 2 for triggering

airbag 15 and/or belt tensioner 16, as well as a crash sensor S2 integrated into the right front end of motor vehicle 1 and a crash sensor S3 integrated into the left front end of motor vehicle 1. Crash sensors S2 and S3 are connected to control unit 2 by leads 5 and 6.

Crash sensors S2 and S3, as well as an additional crash sensor S1 integrated into control unit 2, as shown in Fig. 2, take the form of acceleration sensors in the present exemplary embodiment. Suitable acceleration sensors are described, for example, in chapter 3.2, 'Acceleration Sensor,' of the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf. Examples of suitable acceleration sensors include Bosch SMB060, Bosch PAS3 or Bosch UPF1. A suitable acceleration sensor may include, for example, a Bessel low-pass filter having a cutoff frequency of, e.g. 400 Hz. Crash sensors S1, S2, and S3 supply acceleration values aS1, aS2, and aS3, respectively, as output signals.

The occupant protection system additionally includes a belt sensor 11 for detecting if a seat belt is being used, and for outputting a corresponding belt information item MBELT. The occupant protection system further includes a seat-occupancy sensor 12 for detecting if, or how, a seat is occupied, and for outputting a corresponding seat-occupancy information item MSEAT. An example of a suitable seat-occupancy sensor is a pressure sensor integrated into the seat. Also suitable is an infrared scanning system described in chapter 3.3, "Interior Sensing," of the article "Hardware and Mechanics of Real Airbag Control Systems" published on the Internet page www.informatik.uni-dortmund.de/airbag/seminarphase/hardware_vortrag.pdf. Infrared scanning and fuzzy logic not only allow seat

occupancy to be detected, but also allow a determination as to whether the seat occupant is an object, such as a purse, or a person. To this end, a line of, e.g. eight or more light-emitting diodes above the seat emit infrared light, and a CCD matrix of 64 pixels records the scene illuminated in this manner. These charged coupled devices, abbreviated CCD, are made up of photodiodes and amplifier elements in matrix configurations. In this context, incident light releases charge carriers in each instance. A signal generated in this manner is amplified, processed, and stored. This procedure is repeated at different angles, and the seat is scanned in this manner. Image-processing algorithms and fuzzy-logic algorithms detect contours of objects and persons from these signals.

It may also be provided that the occupant-protection system include a control element 14 for activating or deactivating airbag 15. A corresponding switching signal is designated by reference character ONOFF.

Control unit 2 includes a control module 10 for calculating and outputting an ignition signal AIR fur airbag 15 and/or an ignition signal BELT for belt tensioner 16 as a function of acceleration values aS1, aS2, and aS3, belt information item MBELT, seat-occupancy information item MSEAT, and switching signal ONOFF.

Fig. 3 shows an exemplary embodiment of control module 10. Control module 10 includes a triggering module 20 for calculating and outputting an ignition recommendation CRASH as a function of acceleration values aS1, aS2, and aS3. Control module 10 additionally includes a firing table 21 for calculating and outputting ignition signal AIR for airbag 15 and/or ignition signal BELT for belt tensioner 16 as a function of ignition recommendation CRASH, belt information

item MBELT, seat-occupancy information item MSEAT, and switching signal ONOFF. Thus, it may be provided that ignition signal AIR only be equal to ignition recommendation CRASH, when a corresponding seat is occupied by a person of a specific size, and that ignition signal AIR otherwise be equal to 0.

Both ignition recommendation CRASH and ignition signals AIR and BELT may be ignition signals within the meaning of the claims. Both ignition recommendation CRASH and ignition signals AIR and BELT may be a binary signal, e.g. in accordance with the "FIRE/NO-FIRE" signal described in DE 100 35 505 A1, which indicates whether an occupant protection device, such as an airbag and/or a belt tensioner, should be triggered. Both ignition recommendation CRASH and ignition signals AIR and BELT may also be a more complex signal. Both ignition recommendation CRASH and ignition signal AIR may be, for example, a more complex signal which indicates the degree (e.g. stage 1 or stage 2) to which airbag 15 should be fired. Both ignition recommendation CRASH and ignition signal AIR may additionally include, for example, a crash-severity parameter described in DE 100 35 505 A1 or an occupant acceleration or occupant loading. It may be provided that both ignition recommendation CRASH and ignition signals AIR and BELT can indicate the location and/or the direction of a collision.

Fig. 4 shows an exemplary embodiment of triggering module 20. Triggering module 20 includes an analog-to-digital converter 25 (analog-to-digital converter) for sampling acceleration value aS1 and outputting a sampled acceleration value as1, an analog-to-digital converter 26 for sampling acceleration value aS2 and outputting a sampled acceleration value as2, and an analog-to-digital converter 27 for sampling acceleration value aS3 and outputting a sampled acceleration value as3.

The sampling frequency of the Δt of analog-to-digital converters 25, 26, and 27 may be, for example, 4 kHz. Triggering module 20 additionally includes (digital) integrators 31, 32, 33, 34, 35, and 36.

Using integrator 31, a pseudospeed value v0S1 at time t_0 is ascertained according to

$$v0S1 = \int_{t_0-\tau_0}^{t_0} as1 \cdot dt \ ,$$

where $\tau 0$ is the length of a time interval $[t_0-\tau_0, t_0]$ or 40 (cf. Fig. 5). Time t_0 designates the current time, i.e. the current value of time t.

Using integrator 32, a pseudospeed value v1S1 at a time $t_0-\tau_1$ is ascertained according to

$$v1S1 = \int_{t_0-\tau_0-\tau_1}^{t_0-\tau_1} as1 \cdot dt \ .$$

Using integrator 33, a pseudospeed value v2S1 at a time $t_0-\tau_2$ is ascertained according to

$$v2S1 = \int_{t_0-\tau_0-\tau_2}^{t_0-\tau_2} as1 \cdot dt \ .$$

Using integrator 34, a pseudospeed value v3S1 at a time $t_0-\tau_3$ is ascertained according to

$$v3S1 = \int_{t_0-\tau_0-\tau_3}^{t_0-\tau_3} as1 \cdot dt \ .$$

Using integrator 35, a pseudospeed value v0S2 at time t_0 is ascertained according to

$$v0S2 = \int_{t_0-\tau_0}^{t_0} as2 \cdot dt \ .$$

Using integrator 36, a pseudospeed value v0S3 at time t_0 is ascertained according to

$$v0S3 = \int_{t_0-\tau_0}^{t_0} as3 \cdot dt \ .$$

Fig. 5 and Fig. 6 illustrate the effect of integrators 31, 32, 33, 34, 35, and 36. In this context, Fig. 5 shows an example of the curve of (sampled) acceleration value as1 versus time t in the event of a frontal collision of motor vehicle 1 with an obstacle. Fig. 6 shows an example of a curve of pseudospeed value v0S1 for τ_0 = 24ms.

In the exemplary embodiment shown in Fig. 6, τ_1 is 17 ms, τ_2 is 34 ms, and τ_3 is 51 ms. In one advantageous refinement, τ_1 may be 8 ms, τ_2 may be 16 ms, and τ_3 may be 24 ms.

Pseudospeed values v0S1, v1S1, v2S1, v3S1, v0S2, and v0S3 are examples of time averages within the meaning of the present invention.

Triggering module 20 further includes a trigger generator 30 for generating trigger recommendation CRASH. Trigger generator 30 may take the form of a neural network, as shown in Fig. 7 in an exemplary embodiment.

The neural network shown in Fig. 7 includes six input nodes 50, 51, 52, 53, 54, 55, six covered nodes 60, 61, 62, 63, 64, 65, and an output node 70, each input node 50, 51, 52, 53, 54, 55 being connected to each covered node 60, 61, 62, 63, 64, 65, and each covered node 60, 61, 62, 63, 64, 65 being connected to output node 70. In Fig. 7, however, not all of the connections between input nodes 50, 51, 52, 53, 54, 55 and covered nodes 60, 61, 62, 63, 64, 65 are shown for reasons of clarity.

Pseudospeed value v0S1 is the input variable input into input node 50,

pseudospeed value v1S1 is the input variable input into input node 51,

pseudospeed value v2S1 is the input variable input into input node 52,

pseudospeed value v3S1 is the input variable input into input node 53,

pseudospeed value v0S2 is the input variable input into input node 54, and

pseudospeed value v0S3 is the input variable input into input node 55.

The output variable from output node 70 is ignition recommendation CRASH.

Details regarding neural networks may be found in U.S. 5,583,771, U.S. 5,684,701, and the documents "Techniques And Application Of Neural Networks", Taylor, M. and Lisboa, Ellis Horwood, West Sussex, England, 1993, "Naturally Intelligent Systems", Caudill, M. and Butler, G., MIT Press, Cambridge, 1990, and "Digital Neural Networks", Kung, S. Y., PTR Prentice Hall, Englewood Cliffs, NJ, 1993, cited in U.S. 5,684,701.

Table 1

```
/* Evaluation function */
int evaluate_Action(double *x)
{
	int CRASH;

	if (v0S3 < δ_v0S3 ) {
		if (v0S2 < δ_v0S2 ) {
			if (v2S1 < δ_v2S1 ) {
				if (v0S1 < δ_v0S1 ) {
					CRASH = 0;
				} else {
					if (v0S3 < δ_v0S3,2 ) {
						CRASH = 0;
					} else {
						if (v0S1 < δ_v0S1,2 ) {
							if (v1S1 < δ_v1S1 ) {
								CRASH = 1;
							} else {
								CRASH = 0;
							}
						} else {
							CRASH = 1;
						}
					}
				}
			} else {
				if (v0S2 < δ_v0S2,2 ) {
					CRASH = 0;
				} else {
					if (v0S3 < δ_v0S3,3 ) {
						CRASH = 0;
					} else (
						CRASH = 1;
					}
				}
			}
		} else {
			CRASH = 1;
		}
	} else {
		CRASH = 1;
	}
	return (CRASH);
}
```

As an alternative, trigger generator 30 may take the form of a sequence of comparisons to limiting values. Table 1 shows such a sequence of comparisons to limiting values, the code

shown in Table 1 having been automatically generated by a learning process. For the code shown in Table 1, τ_1 is 4 ms, τ_2 is 8 ms, and τ_0 is 24 ms.

Fig. 8 shows the code of Table 1 represented as a decision tree 80. In this context, reference numeral 81 denotes the inquiry as to whether v0S3 is less than a limiting value δ_{v0S3}. Reference numeral 82 denotes the inquiry as to whether v0S2 is less than a limiting value δ_{v0S2}.
Reference numeral 83 denotes the inquiry as to whether v2S1 is less than a limiting value δ_{v2S1}.
Reference numeral 84 denotes the inquiry as to whether v0S1 is less than a limiting value δ_{v0S1}.
Reference numeral 85 denotes the inquiry as to whether v0S3 is less than a limiting value $\delta_{v0S3,2}$.
Reference numeral 86 denotes the inquiry as to whether v0S1 is less than a limiting value $\delta_{v0S1,2}$.
Reference numeral 87 denotes the inquiry as to whether v1S1 is less than a limiting value δ_{v1S1}.
Reference numeral 88 denotes the inquiry as to whether v0S2 is less than a limiting value $\delta_{v0S2,2}$.
Reference numeral 89 denotes the inquiry as to whether v0S3 is less than a limiting value $\delta_{v0S3,3}$.

According to Fig. 8 and Table 1, trigger generator 30 disregards pseudospeed value v3S1. This is taken into account in the learning process, but is disregarded by the learning algorithm for generating the code according to Table 1.

Fig. 9 shows an exemplary embodiment of a triggering module 120 that is an alternative to triggering module 20. In this context, integrators 32, 33, and 34 are replaced by lag elements 132, 133, and 134, which are positioned in such a manner, that pseudospeed value v1S1 results as pseudospeed value v0S1 delayed by time τ_1, pseudospeed value v2S1 results

as pseudospeed value v0S1 delayed by time τ_2, and pseudospeed value v3S1 results as pseudospeed value v0S1 delayed by time τ_3.

One example of a possible (simple) implementation of integrator 31 (and appropriately adapted for integrators 32, 33, and 34) is

$$vS1(i) = c \cdot \Delta t \sum_{j=i-\frac{\tau_0}{\Delta t}}^{i} as1(j),$$

where i is a running index for specifying current time t_0 and is a constant. In this case, pseudospeed values v0S1, v1S1, v2S1, and v3S1 are yielded, for example, in accordance with the following relationships:

$$v0S1 = vS1(i)$$

$$v1S1 = vS1\left(i - \frac{\tau_1}{\Delta t}\right)$$

$$v2S1 = vS1\left(i - \frac{\tau_2}{\Delta t}\right)$$

$$v3S1 = vS1\left(i - \frac{\tau_3}{\Delta t}\right)$$

Fig. 10 shows an exemplary embodiment of a triggering module 220 that is an alternative to triggering module 20. In this context, integrators 32, 33, and 34 are replaced by integrators 232, 233, and 234. In this context, pseudospeed value v1S1 is ascertained via integrator 232 according to

$$v1S1 = \int_{t_0-\tau_1}^{t_0} as1 \cdot dt \ .$$

Using integrator 233, a pseudospeed value v2S1 at time t_0 is ascertained according to

$$v2S1 = \int_{t_0-\tau 2}^{t_0} as1 \cdot dt \ .$$

Using integrator 234, a pseudospeed value v3S1 at a time t_0 is ascertained according to

$$v3S1 = \int_{t_0-\tau 3}^{t_0} as1 \cdot dt \ .$$

In triggering module 20 according to Fig. 4 and triggering module 120 according to Fig. 9, the time intervals differ in their position. However, in triggering module 220 according to Fig. 10, the time intervals differ in their length. It may also be provided that time intervals differ in their length and in their position. A corresponding exemplary embodiment is shown in Fig. 11. Fig. 11 shows an exemplary embodiment of a triggering module 320 that is an alternative to triggering module 220. In this context, integrator 234 is replaced by an integrator 334, with the aid of which a pseudospeed value v3S1 at a time $t_0-\tau_4$ is ascertained according to

$$v3S1 = \int_{t_0-\tau_3-\tau_4}^{t_0-\tau_4} as1 \cdot dt \ .$$

In particular, in connection with neural networks, automatically generated decision trees, or comparable, learning, evaluation procedures, the present invention produces especially robust control of airbags and belt tensioners.

Although explained in the exemplary embodiments in view of airbags and belt tensioners for a frontal collision, the present invention should not, of course, be restricted to this case. The present invention is also applicable to side airbags and other occupant protection systems. In one implementation for side airbags, crash sensors S2 and S3 may

be situated, for example, in the B-pillar. It may be provided that at least one pseudospeed value over at least one additional time interval be calculated for crash sensor S2 and/or crash sensor S3, as well.

A control unit within the meaning of the present invention may also be a distributed system. A control unit within the meaning of the present invention does not have to be accommodated in a single housing. A control unit within the meaning of the present invention may also be an individual chip or a printed circuit board.

To the extent that decision trees are mentioned in connection with the generation of ignition recommendation CRASH, these may also be replaced by regression trees, association tables, rule sets, supervector machines, or other machine-learning procedures.

Instead of motion variables or their average values, differences of motion variables, average values of these differences, and/or differences of average values may also be used. Thus, e.g. a subtractor may be provided in front of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334 in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, so that instead of sampled acceleration values as1, as2, as3, differential values Δas1, Δas2, Δas3 are input variables of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334, Δas1 being equal to difference as1-as2, Δas2 being equal to difference as1-as3, and Δas3 being equal to difference as2-as3. In addition, it may be provided that differential value Δas1 be processed in the same manner as sampled acceleration value as1 in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, that differential value Δas2 be processed in the same manner as sampled acceleration value as1 in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11, and/or that differential value Δas3 be processed in the same manner as

sampled acceleration value as2 in Fig. 4, Fig. 9, Fig. 10, and/or Fig. 11. In this case, the number of integrators and the number of input variables are to be appropriately adapted to trigger generator 30.

Differences may also be time differences. Thus, it may be provided that differential values Δas1, Δas2, Δas3 be used in place of sampled acceleration values as1, as2, as3 as input variables of integrators 31, 32, 33, 34, 35, 36, 232, 233, 234, and 334, Δas1(t) being equal to difference as1(t)-as1(t-τ), Δas2 being equal to difference as2(t)-as2(t-τ) or difference as2(t)-as3(t-τ), and Δas3 being equal to difference as3(t)-as3(t-τ) or difference as3(t)-as2(t-τ).

In accordance with above-mentioned variants with regard to the calculation of a difference, motion variables within the meaning of the present invention may also be differences of motion variables, when they are used as input variables.

One may proceed with pseudospeed values v0S1, v1S1, v2S1, v3S1, v0S2, v0S3 in an analogous manner. Accordingly, average values of motion variables within the meaning of the present invention may also be differences of average values of motion variables or average values of differences of motion variables, when they are used as input variables.

List of Reference Numerals

1	motor vehicle
2	control device
5, 6	leads
10	control module
11	belt sensor
12	seat-occupancy sensor
14	control element
15	airbag
16	belt tensioner
20, 120, 220, 320	triggering module
21	firing table
25, 26, 27	analog-to-digital converter
30	trigger generator
31, 32, 33, 34, 35, 36, 232, 233, 234, 334	integrator
40	time interval
50, 51, 52, 53, 54, 55	input node
60, 61, 62, 63 64, 65	covered node
70	output node
80	decision tree
81, 82, 83, 84, 85, 86, 87, 88, 89	inquiry
132, 133, 134	lag element
AIR, BELT	ignition signal
aS1, aS2, aS3, as1, as2, as3	acceleration value
CRASH	ignition recommendation
ONOFF	switching signal
MBELT	belt information
MSEAT	seat-occupancy information

S1, S2, S3	crash sensor
t	time
t0	current time
v0S1, v1S1, v2S1, v3S1, v0S2, v0S3	pseudospeed value
τ_0, τ_1, τ_2, τ_3	length of a time interval